The Namibian poliomyelitis outbreak and its consequences for South Africa

This editorial is based on a Public Health Forum presented by the Centre for Infectious Diseases at the Faculty of Health Sciences, Stellenbosch University, on 22 June 2006. It summarises the most important facts about polio in the context of the 2006 outbreak of the disease in Namibia and aims to provide the practitioner with the necessary information to face the unexpected re-emergence in the sub-region of an almost forgotten disease.

Clinical aspects of polio

Prof. Mark Cotton (Paediatric Infectious Diseases)

The "typical" clinical picture of poliomyelitis (commonly referred to as "polio") is characterised by acute flaccid paralysis due to lower motor neuron damage. Patients suffer from weakness of the skeletal or cranial muscle groups and have an "anxious" facial expression. Superficial or deep reflexes disappear before the onset of paralysis, and there frequently is a symptom-free period, followed by the recurrence of symptoms and paralysis. The lower limbs are affected worse than the upper extremities. Autonomic instability, bladder paralysis and ileus can also occur.

Death may occur due to respiratory paralysis unless patients are put on artificial respirators (in the 1950s, the famous "iron lung" was used for such cases). The differential diagnosis includes Guillain-Barré syndrome (GBS), infection with neuropathogenic (non-polio) enteroviruses, rabies, botulism, and intoxications. Both congenital and neonatal polio may occur.

Some recovery of muscular function is common in survivors, but this may take six months or longer. In epidemics in developed countries in the early 1950s, typically 5% of cases were fatal, 10% showed full recovery with no sequelae, while the remainder showed permanent paralysis to some degree. However, neurological involvement as the most severe manifestation of poliovirus infection occurs in only around 1% of those infected and is thus the exception rather than the rule. Much more commonly, poliovirus infection is asymptomatic or mild. The risk for paralytic disease increases with age (older patients also have a higher mortality rate), during pregnancy, following tonsillectomy (when bulbar polio disease occurs), recent DTP vaccination or trauma, and in those undertaking strenuous physical exercise.

Abortive polio or "minor illness" includes fever (normally lower than in patients suffering from paralytic disease), malaise, anorexia and a sore throat. It normally lasts for about 72 hours. Some of these patients may progress to non-paralytic poliomyelitis or aseptic meningitis after a short interlude. They will suffer from fever, headache, neck stiffness, aching muscles, occasionally hyper- or paresthesia and symptoms such as anorexia, nausea, vomiting, diarrhoea or constipation. Recovery usually ensues after three to ten days.

The treatment is supportive; the only antiviral agent with anti-enterovirus activity is Pleconaril, which has been used in one child with vaccine-associated polio; however, this drug is currently not licensed.

Viruses, vaccines, and eradication

Prof. Wolfgang Preiser (Virology)

Polio is the opposite of an emerging infectious disease: it is a very old disease of mankind and hopefully soon will be a thing of the past. The old Egyptians depicted individuals with the typical sequelae of paralytic polio. In 1909, Landsteiner and Popper successfully transmitted the disease to nonhuman primates and, in 1949, Enders, Weller and Robbins first propagated poliovirus in vitro in cell culture.

There are three serotypes, polioviruses 1, 2 and 3. They belong to the genus Enterovirus of the family Picornaviridae (derived from the Italian: pico = small, with a diameter of only 25 nm, and RNA for the viral nucleic acid). Polioviruses are non-enveloped and thus resistant to many commonly used detergents and disinfectants; at +4 ºC they remain infectious for weeks, and at room temperature will remain still for days.

Polioviruses enter the body via the oral route and replicate in the throat and gastrointestinal tract. The incubation period to the onset of paralysis is 10 to 21 days. Large quantities of the virus are shed in the faeces for prolonged periods (typically several weeks). Transmission is faeco-orally, either directly from person to person (e.g. within households) or indirectly, e.g. via contaminated food or water, especially if hygiene and sanitation standards are poor.

Industrialised countries have seen improving hygiene during the 20th century, which, paradoxically, has made the polio problem worse by shifting the age at which the poliovirus infection is acquired from young childhood to higher age groups. With almost ubiquitous environmental contamination, nearly everyone was exposed within the first years of life, i.e. at an age when the chance of developing paralytic illness is comparatively small, followed by life-long immunity – an endemic situation. In contrast, higher age groups have a relatively higher risk of suffering severe manifestations should they become infected, which means that the numbers of paralytic cases increase despite an overall reduction in the number of infections. In addition, this infection often happened in waves, leading to an epidemic situation. In 1952, 21 000 cases of paralytic poliomyelitis were reported in the USA, and considerable efforts were undertaken to combat this dreaded disease.

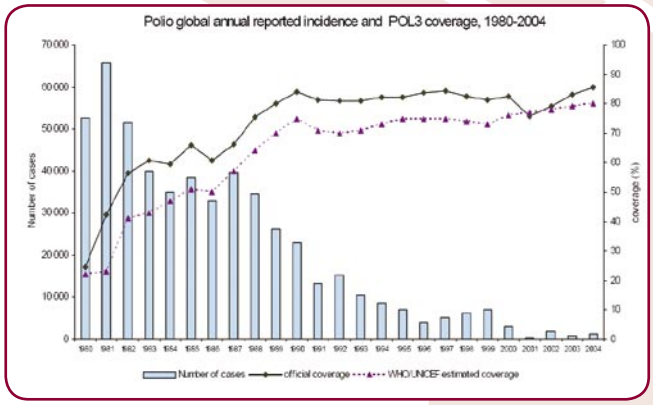
In 1954, Jonas Salk produced the first successful poliovirus vaccine. The Salk vaccine is trivalent (i.e. contains all three serotypes) and consists of formalin-inactivated viruses. It is known as IPV (inactivated poliovirus vaccine). In 1961, a live attenuated poliovirus vaccine developed by Albert Sabin was licensed following extensive trials. It is known as OPV (oral poliovirus vaccine) and is normally used in its trivalent (tOPV) form, but more recently also for poliovirus type 1 only (monovalent OPV = mOPV).

Both IPV and OPV have pros and cons. The oral (live attenuated) polio vaccine (OPV) is temperature sensitive, i.e. a reliable cold chain is required. However, it does not require injection. The vaccine viruses replicate in the vaccinee (meaning that comparatively smaller doses may be administered), and they induce mucosal immunity in the gut. OPV is almost 100% effective and, in addition, provides contact immunity: ~ 25% of close contacts of vaccinees will be immunised inadvertently by becoming infected with the vaccine strains shed by vaccinees. A rare but significant side effect is vaccine-associated paralytic polio (VAPP). This complication occurs in one out of every two to three million doses OPV in susceptible individuals.

Inactivated (injectable) polio vaccine (IPV) is more stable, but requires injection. It does not reproduce in the vaccinee (therefore higher doses of antigen need to be given, and booster doses are required), but there is no risk of VAPP and it is unproblematic in immunocompromised and pregnant individuals. IPV does not induce mucosal immunity in the gut, it is not transmitted and therefore does not provide contact immunity.

The current vaccination schedule in South Africa includes OPV given routinely to all children at birth, 6 weeks, 10 weeks, 14 weeks, 18 months and 5 years of age. Most importantly, polio vaccination works! Figure 1 shows the relationship between global coverage with three doses of OPV between 1980 and 2004 and the annual reported incidence of polio disease.

Figure 1: Global annual reported incidence of polio and coverage with three doses of OPV, 1980-2004 (Source: WHO vaccine-preventable diseases: monitoring system; 2005 global summary).



The success of polio vaccination was so impressive that, in 1988, the World Health Assembly agreed to a worldwide eradication programme, making polio the second disease ever to be eradicated (after smallpox). The original plan was for the world to be certified polio-free by 2000, but this first had to be delayed to 2005 and is now without a set date due to recent setbacks.

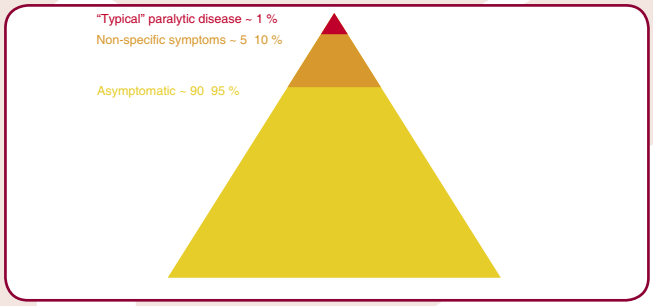
The following factors make it feasible to try to eradicate polio:

- it affects only humans, as there is no animal reservoir;
- an effective, safe and inexpensive vaccine is available;
- immunity following either immunisation or natural infection is reliable and long-lasting;
- there is no long-term carrier state (unfortunately this is not quite true, as we now know that individuals with agammaglobulinaemia do not clear the infection and may shed OPV strains for years or decades); and
- poliovirus does not survive very long in the environment.

The polio eradication strategy is based on the following components:

1. High routine infant immunisation coverage: at least three doses of OPV, plus a dose at birth in polio-endemic countries, for at least 80% of children (South Africa has a coverage target of 90%).
2. National immunisation days (NIDs): mass polio immunisation campaigns during which all children younger than five years are immunised, irrespective of their immunisation history, with two doses of OPV during two rounds; the aim is to rapidly interrupt possible chains of polio transmission.
3. Acute flaccid paralysis (AFP) surveillance: the purpose of this is to detect possible cases of polio. This is achieved by targeting the "tip of the iceberg", i.e. the small percentage of infected individuals who suffer from "classic" paralytic polio disease (see Figure 2). The target is notification of at least one case of AFP (due to GBS or other non-traumatic causes) per 100 000 children up to 15 years of age a year. At least 80% of these AFP cases must receive adequate laboratory investigations (by means of two stool samples obtained within two weeks of onset and tested for poliovirus). If these standards are fulfilled, AFP surveillance is functioning adequately and will be able to detect polio cases if they were to occur.

Figure 2: "Classical" clinical cases of polio(myelitis), targeted by AFP surveillance, are just the "tip of the iceberg"



4. Mop-up immunisation campaigns to interrupt final chains of transmission: house-to-house vaccination of all children younger than five years of age within a high-risk geographic area or population with

two doses of OPV, again regardless of previous immunisation history.

The last laboratory-confirmed case of polio in South Africa occurred in KwaZulu-Natal in 1989. AFP was made notifiable in 1994, and several national polio immunisation campaigns have been conducted (in 1995, 1996, 1997 and 2000; in the Western Cape in 2002). South Africa is currently working on the containment of laboratory stocks of wild poliovirus.

The global effort and Rotary's role

Dr Peter Vurgarellis (Rotary)

Rotary is a worldwide organisation of business and professional leaders that provides humanitarian service, encourages high ethical standards in all vocations, and helps build goodwill and peace in the world. Approximately 1.2 million Rotarians belong to more than 32 000 clubs in more than 200 countries and geographical areas.

Rotary's involvement in polio eradication began in 1979, after a talk by Dr Sabin, with a five-year commitment to provide and help deliver polio vaccine to six million children in the Philippines. It was the first project of the new Health, Hunger and Humanity (3-H) programme. In the next four years, similar five-year commitments were approved for Haiti, Bolivia, Morocco, Sierra Leone and Cambodia.

In the early 1980s, Rotary began planning for the most ambitious programme in its history – to immunise all of the world's children against polio. The plan required collaboration with international, national and local health agencies. Dr Canseco invited Dr Albert Sabin, the developer of the oral polio vaccine, to serve as a special consultant to the committee.

Rotary's pledge of US$120 million to fund its PolioPlus programme was announced in October 1985 at the 40th anniversary of the United Nations (UN). This ambitious commitment electrified the global public health community. Within three years, Rotarians had more than doubled their fundraising goal, donating US$247 million. By the time the world is certified polio free, Rotary's contribution to the global polio eradication effort will exceed US$600 million.

PolioPlus funds have funded transportation and other operational costs associated with vaccine delivery, surveillance efforts (including laboratory needs) to identify areas where the virus circulates, and training for healthcare workers and volunteers involved in the immunisation process.

Rotarians have delivered vaccine by camels, helicopters, trucks and motorbikes, staffed immunisation posts, raised community awareness of the value of immunisation and, in the process, have helped to mobilise 10 million volunteers.

The Global Polio Eradication Initiative is recognised worldwide as a model of public and private cooperation in pursuit of a humanitarian goal. In the words of UN General Secretary Kofi Annan, "Rotary's PolioPlus programme is a shining example of the achievements made possible by cooperation between the UN and non-governmental organisations".

The Namibian polio outbreak: re-introduction into fertile soil

Dr Gert van Zyl (Virology)

As of 28 June 2006, at least 17 people have died and 136 have presented with paralysis in a polio outbreak in Namibia that started in May 2006. Before the outbreak, Namibia had been polio free since 1995. So how did this happen?

The widely used emerging infectious disease news list, Promed, reported on 2 June 2006 that "panic is sweeping through suburbs north of Katutura" (i.e. near the capital Windhoek) after three people had died and 19 others were hospitalised with a disease that then still had to be identified. At that stage it was unclear what the aetiology of this paralytic disease was; the age of those affected in fact made polio an unlikely candidate, at least according to "experts".

The index case – which is not necessarily the "first" case in the outbreak but somebody with access to private health care and thus state-of-the-art laboratory diagnosis – was a 39-year-old man from Aranos, 450 km by road from Windhoek. He was admitted to a private hospital in Windhoek on 25 April and underwent a cholecystectomy on 27 April. He was then discharged and initially recovered well.

However, he then fell ill again with rigors and fever, stomach pain and tenderness and, on 8 May, had an onset of weakness in his legs and dyspnoea. He was subsequently referred to Windhoek, where he was intubated and ventilated. A stool specimen was collected on 15 May. A type 1 poliovirus was isolated from the specimen and determined to be wild-type virus by the National Institute for Communicable Diseases (NICD) in Johannesburg.

Namibia is a vast country with only about two million inhabitants. Its Gini coefficient (a measure of income disparity) is one of the highest in the world, at 70.7 on a scale up to 100, with 0 representing perfect equality. Its performance with respect to routine polio immunisation coverage and AFP surveillance meets WHO targets: coverage with three doses of OPV is around 80%, and AFP notifications stand at 2/100 000, with an adequate stool collection rate of 88%.

The country nevertheless provided fertile soil for the current outbreak. Katutura means "a place to stay" or "we have no per-manent habitation" in the Herero language and is a partially informal settlement in which 60% of Windhoek's 200 000 inhabitants live. Of these, 30% did not have adequate sanitation in 2001. Katutura also serves as a reception area for immigrants from rural Namibia and neighbouring countries such as Angola.

A genetic analysis of the index case's virus by the NICD showed that the Namibian isolate was closely related to type 1 polioviruses isolated in Benguela province in Angola in May and June 2005 and which belonged to a South Asian genotype that originated in India. Angola has only 42% OPV coverage. The last polio case there was notified in November 2005.

One is left to wonder what happened between then and May 2006, when this virus re-emerged in Namibia. Had there perhaps been a "silent epidemic", with AFP cases being missed either in Angola or Namibia, despite seemingly adequate vaccination rates?

Unusual features of the ongoing Namibian outbreak

are the age groups affected. The initial 34 AFP cases had ages ranging from 5 to 76 years; 13 of the 18 cases with age indicated (72%) are people between the ages of 20 and 35 years. This is highly unusual for polio. The death rate of 15 out of 96 cases is also unusually high.

Possible explanations could be that the adults were not immunised and, due to a lack of natural exposure in sparsely populated Namibia prior to the vaccination era, had not been infected with wild polioviruses. Primary or secondary vaccine failure might also play a role. A higher age at infection means a higher attack rate for AFP and increased severity, which could explain the observed high mortality, although the mode of exposure and size of the inoculum may also have contributed to this.

By the time polio was established as the aetiology behind the cases of paralysis, seven deaths had already occurred and more than twenty AFP cases had been reported. It can only be speculated how the silent infections would have occurred (see Figure 2). In response, the entire Namibian population was targeted in a NID using monovalent OPV-1 on 21 June 2006; two more NIDs are planned.

The most important lesson to be learnt from this crisis is that each and every case of AFP is important and must be diagnosed appropriately. It also shows that political and socio-economic factors remain important.

The South African response to the polio outbreak in Namibia

Dr Neil Cameron (Public Health)

To prepare South Africa for the possible importation of polio from neighbouring Namibia, awareness amongst healthcare staff has been heightened through circulars, etc. to ensure the immediate reporting of suspected cases to allow for prompt investigation and an appropriate and timely response. The importance of personal hygiene has been stressed and advice has been issued for travellers to Namibia. Immunisation for travellers is being provided at primary care clinics. Because the Namibian outbreak seems to largely affect adults rather than children, AFP surveillance has been extended to all age groups (instead of only those younger than 15).

The definition of suspected polio is any case of AFP characterised by sudden loss of strength, tone and/or reflexes in a limb or limbs in a child aged younger than 15 years, for which no other presenting cause such as trauma is evident at onset. Such cases of AFP must be reported even if they do not "look like polio", even if the child is fully vaccinated, and even if the onset occurred up to 60 days previously. A case investigation form must be completed, recording accurate address information to facilitate tracing and follow-up. Two stool specimens are collected 24 hours apart and shipped frozen to the designated laboratory at NICD in Johannesburg. The infection control staff at provincial and private hospitals or staff at the nearest Public Health Laboratory Service should be able to provide details of specimen collection and shipment.

In addition to increased monitoring and strengthening of routine immunisation coverage, the national mass immunisation campaign originally planned for July 2007 is being brought forward to September 2006.

Recommendations for travellers

Dr Jantjie Taljaard (Adult Infectious Diseases)

Not very much is known about the current outbreak in Namibia as regards its epidemiology, geographic spread, etc. However, the potential severity of the disease, which may lead to irreversible paralysis and even death, is well documented. In comparison, the risk associated with the only specific intervention, immunisation, is insignificant.

The Epidemiology Unit of the NICD issued a recommendation on 15 June 2006 that all travellers to Namibia (including returning residents) are advised to obtain a booster dose of polio vaccine at least 10 to 14 days before travelling. Should travel commence sooner than 10 to 14 days, the individuals should still be immunised (the idea behind this probably being that although specific immunity will not develop soon enough, the "ecological niche" in the gastrointestinal tract will be occupied by OPV strains and thus will not be available for wild poliovirus).

Trivalent OPV is the vaccine best suited for eradicating polio as it provides herd immunity, is cheap, easily accessed and recommended by the WHO. It is currently provided free of charge at government clinics. It is safe, with a very low rate of vaccine-associated polio paralysis (VAPP). The only absolute contraindication to vaccination with OPV is severe humeral immunodeficiency. For these individuals, IPV alone is available as a Section 21 drug through the Medicines Control Council (MCC) or using the combination tetanus, diphtheria and IPV (TdP) vaccine. IPV is also recommended for pregnant women undertaking essential travel to Namibia. In addition, one should also consider giving IPV to those with severe immunosuppression and to adults who have never before been immunised against polio.

As polio is transmitted via the faecal-oral route, it is extremely important that high levels of general hygiene be maintained at all times. This includes frequent hand washing and the consumption of clean (preferably bottled) water and non-contaminated food.

No vaccination is recommended for people entering South Africa from Namibia. These people should be advised to report to the nearest healthcare facility if they develop acute onset of paralysis and to inform the healthcare worker of their visit to Namibia.

Taljaard J, MBChB, MMed (Intern), DTM&H, Cert ID
Centre for Infectious Diseases, University of Stellenbosch
Cameron N, MBChB, DCH (SA), DTM&H, BScHons (Epidemiology), FCPHM (SA)
Centre for Infectious Diseases, University of Stellenbosch
Cotton M, MBChB, FCPaed, MMed (Paed), DTM&H, DCH (SA), PhD, Cert ID
Centre for Infectious Diseases, University of Stellenbosch
Van Zyl G, MBChB, FCPath (SA) Virol, MMed Pathology (Virol), BScHons (Epidemiology)
Centre for Infectious Diseases, University of Stellenbosch
Vurgarellis P, MBChB, FFCH(CM)(SA)
Rotary International
Preiser W, Dr med, Dr med habil, DTM&H, MRCPath
Centre for Infectious Diseases, University of Stellenbosch

Correspondence to: Dr J Taljaard, e-mail: jjt@sun.ac.za